



Alternative agricultural price distortions for CGE analysis, 2007 and 2011

Jensen, Hans Grinsted; Anderson, Kym

Publication date:
2014

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Jensen, H. G., & Anderson, K. (2014). *Alternative agricultural price distortions for CGE analysis, 2007 and 2011*. GTAP, Purdue University. GTAP Research Memorandum No. 27
https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=4364



**Alternative Agricultural Price Distortions for
CGE Analysis, 2007 and 2011**

By

Hans G. Jensen¹

and

Kym Anderson²

GTAP Research Memorandum No. 27

March 2014

The authors are grateful for helpful interactions with Anna Strutt and for funding support from the Australian Research Council, the Rural Industries Research and Development Corporation, and the University of Copenhagen.

¹ University of Copenhagen, hans@ifro.ku.dk

² University of Adelaide and Australian National University, kym.anderson@adelaide.edu.au

Alternative Agricultural Price Distortions for CGE Analysis, 2007 and 2011

Hans G Jensen and Kym Anderson

A recent World Bank research project has generated an annual time series of distortions to agricultural incentives over the past half century for 82 countries, the majority of which are low-and middle-income countries (Anderson and Valenzuela 2008; Anderson and Nelgen 2013).¹ This new dataset can provide an alternative set of estimates of agricultural price distortions in developing countries to those provided for 2007 in the GTAP 8 database and 2011 in the GTAP 9 database (see Narayanan *et. al.* 2012 and forthcoming). This World Bank resource contains ad valorem tax/subsidy rates on outputs, inputs, imports and exports by country, for as many as 75 agricultural products (around a dozen per country on average).

As explained in the methodology paper for the World Bank project (Anderson et al. 2008), these new estimates of the extent of price distortions in national economies are based on the ratio of actual domestic to border prices. They therefore differ from those in the GTAP database, which are mostly based on just applied rates of import tariffs. They should not be seen as superior to the standard GTAP distortions database, which in combination with detailed information on bound import tariff tariffs and agricultural subsidies in high-income countries is meant for analyzing such things as multilateral and preferential trade policy reforms. Rather, the new dataset provides an alternative for those wishing to focus on the fuller range of distortions to national markets for farm products, as needed for analyses of agricultural and trade policies affecting developing countries.

There are several situations in which the analyst may not want to rely on just applied import tariffs for analyzing the impact of, say, removing all distortions to agricultural incentives. One is that there may be ‘water’ or unused protection in such tariffs (because the government chooses to or finds itself unable to collect duties at the border), in which case the nation’s applied rate overstates the extent of actual protection from import competition for that product. It is also possible that nontariff import barriers exist to such an extent that an applied tariff understates the actual protection level. As well, production or export taxes or other export restrictions, or exchange rate distortions – generally not included in the GTAP protection database for developing countries – may be in place. And value added taxes on agricultural products may be applied at the border on imported products but not (or not as fully) on domestically produced like products. In principle, careful domestic-to-border price comparisons, appropriately adjusted for marketing margins, quality differences, etc., can overcome these problems and provide a more-accurate indicator of the price-distorting effects of a country’s agricultural and trade policy measures.

¹ In addition to the publicly available database, the project’s website (www.worldbank.org/agdistortions) includes a lengthy series of background, methodology and working papers and underlying national spreadsheets. Country case studies are published in a series of four regional books (Anderson and Martin 2009, Anderson and Masters 2009, Anderson and Swinnen 2008 and Anderson and Valdés 2008) as well as a global overview volume (Anderson 2009). The four regional volumes, and a follow-up volume of CGE studies on the effects of those distortions on income inequality and poverty (Anderson, Cockburn and Martin 2010), are available as free e-books at <http://go.worldbank.org/R34AP8DA80>

The estimates of price distortions for developing countries from the World Bank's Distortions to Agricultural Incentives (DAI) project are decomposed into trade or border instruments, including import and export taxes or subsidies, and domestic instruments such as farm output or input subsidies and consumer tax equivalents.

This DAI database contains data for 71/68 individual countries found in the GTAP database for the 2007/2011 base years of the GTAP version 8/version9 database.² As for specific commodities in individual countries, the DAI database provides an estimate of the nominal rate of assistance (NRA) to producers of the most-valuable dozen or so farm products that comprise around 70% of the gross value of agricultural production in each country. The NRA is the percentage by which domestic producer prices exceed the border price of like products at the same point in the value chain. Hence the NRA is negative if producers receive less than the price they would have for a like product in the absence of government intervention. The NRA captures three domestic policies affecting agricultural producer prices, namely border measures (NRA_{bms}), output subsidies/taxes (NRA_{dms}) and intermediate input subsidies/taxes/import tariffs (NRA_i) so that

$$NRA = NRA_{bms} + NRA_{dms} + NRA_i \quad (1)$$

The sum of the border and domestic output price support measures are based on actual product price comparisons rather than applied tariff rates. In principle, careful domestic to border price comparisons can capture nontariff import barriers as well as producer price subsidies, production or export taxes or other export restrictions, or exchange rate distortions, most of which are generally not included in the GTAP protection data for developing countries. The reported contribution of the ad valorem equivalent input taxes (specific input taxes are multiplied by input-output coefficients and summed up to obtain the combined NRA_i) can be added together with the border measure to give the total NRA estimate by commodity and country.

Looking at consumer incentives, these are affected by border measures NRA_{bms} together with any domestic consumption taxes or subsidies affecting final consumers. In the present version of the DAI database for the years 2007/11, only border measures are affecting consumer prices, with a few exceptions. Hence there is no recalibration of the GTAP database's domestic taxes/subsidies on private and government consumption already found in that database.

Steps in putting NRA estimates into GTAP

In order to recalibrate the GTAP database with NRA estimates, we draw on the latest version of the World Bank's *Distortions to Agricultural Incentives* (DAI) database (Anderson and Nelgen 2013) to alter the GTAP database's estimates of national support and trade restrictions. This involves revising the effort by Valenzuela and Anderson (2008), who made a similar adjustment to the Version 7 GTAP protection database for 2004. In particular, we introduce the NRA estimates of the actual price wedges at national borders and farm output and input subsidies/taxes, using an ALTERNATE closure of the GTAP model (Malcolm 1998).

As mentioned, the DAI database for the year 2007/2011 covers 71/68 countries and a wide range of commodities. In order to aggregate the DAI database to GTAP concordance, a new program (DAItoGTAP) was written, using GEMPACK (Harrison *et al.* 2013), to process the NRA

² The DAI database includes 2011 data for only 42 countries, but it has data up to 2010 for an additional 26 countries. So, in recalibrating the v9 database, those 2010 estimates of distortions are used as a proxy for 2011 (when international prices were similar to those in 2010).

data in a consistent manner and to document our approach. The DAItGTAP program works as follows:

- *first*, it aggregates the World Bank's NRA data consisting of NRA_{bms} , NRA_{dms} , and NRA_i to GTAP commodity concordance,
- *Second*, NRA_{bms} are allocated as price wedges at national borders as either import or export taxes in the GTAP database, depending on a country's trade status as net exporter/importer,
- *third*, GTAP output and input subsidies/taxes are brought into line with the commodity specific NRA_{dms} and NRA_i estimates so that the GTAP database mirrors the DAI database relationship, $NRA = NRA_{bms} + NRA_{dms} + NRA_i$, and
- *fourth*, even though the DAI database also contains estimates of non-product-specific (NPS) assistance and decoupled payments (decpay), the DAItGTAP program does not use this information and does not change the NPS and decoupled payments already found in the GTAP database, with the exception of a few developing countries,³ and
- *fifth*, the DAItGTAP program generates a shock file used in the ALTERTAX program to incorporate the DAI price wedge data into any aggregation of the GTAP database.

Incorporating NRA_{bms}

The aggregation of the DAI commodities to GTAP concordance in each country results in one $NRA_{bms}(i,r)$ measure to compare with the multiple ad valorem tariffs and export taxes found in the GTAP database for commodity i being imported from or exported to s countries to/from country r . We therefore make the assumption that the estimated $NRA_{bms}(i,r)$ represents the average trade distortion on GTAP commodity i in country r .⁴

More precisely, the $NRA_{bms}(i,r)$ is measuring the percentage price difference between the domestic farm gate price PP and the world marker border price BP,

$$NRA_{bms}(i,r) = 100 * (PP(i,r) - BP(i)) / BP(i) \quad (2)$$

In GTAP terms this would be equivalent to:

$$NRA_{bms}(i,r) = 100 * [\text{sum}(s, \text{REG}, (VIMS(i,s,r) / VIWS(i,s,r))) - 1] \quad (3)$$

or

$$NRA_{bms}(i,r) = 100 * [\text{sum}(s, \text{REG}, (VXMD(i,r,s) / VXWD(i,r,s))) - 1] \quad (4)$$

As the $NRA_{bms}(i,r)$ measures the percentage by which the domestic producer price differs from the border price, the question arises as to which border restriction is responsible for the price

³ The DAI database's NPS and decpay estimates stem mainly from the OECD's PSE tables. Since the OECD PSE tables already are the source of domestic support embedded into the GTAP database, the DAItGTAP program makes no change to the land, labor, capital, and intermediate input subsidies/taxes already found in the database, where NPS and decpay support already are allocated. In some developing countries the DAI's NPS estimates are calibrated into the GTAP database as homogenous intermediate input subsidies, which is added to the any commodity specific NRA_i in primary agricultural production.

⁴ For the EU countries, intra-EU trade is excluded when calculating average trade barriers faced by non-member countries.

gap? In the DAItGTAP program, this is determined by using the self-sufficiency estimate (domestic share in total use) calculated using the initial GTAP database. If the self-sufficiency ratio is above 1.01, we allocate the country to be an exporter, otherwise an importer.

Since the $NRA_{bms}(i,r)$ estimates are linked to primary agricultural products, which first have to pass through processing industries before being consumed, we aggregate the primary GTAP commodities pdr, osd, c_b, ctl, oap, rmk together with their respective processed products pcr, vol, sgr, cmt, omt mil before calculating self-sufficiency ratios in each country.⁵

In a similar manner, when allocating the $NRA_{bms}(i,r)$ border distortion for the primary commodities listed above, we also allocate the same border distortion to the associated processed sector. It is assumed for these products that the estimated price gap in the DAI database is at a higher level in the value added chain (processed products) and that wholesale prices (WP) are used instead of farm-gate prices (PP) for comparison with associated border prices (BP). The estimated relative percentage price gap ($NRA_{bms}(i,r)$) for the processed products is then allocated to the associated primary production at the farm gate in the DAI database. Using this assumption, we allocate the same border price distortion in both primary and the associated secondary processing industries found in the GTAP database.

For GTAP commodities where the self-sufficiency is equal to or below 1.01, the country is classified as an importer. The $NRA_{bms}(i,r)$ border distortions are then calibrated into the GTAP database by changing initial import tariffs. In the DAItGTAP program *two methods* of incorporating the $NRA_{bms}(i,r)$ as changes to import tariffs are available.

The *first method* follows the approach used by Valenzuela and Anderson (2008), where the preferential bilateral tariff structures ($TMS(i,s,r)$) originally included in the GTAP version 8 Database are maintained by multiplying each bilateral tariff by the ratio of the import tariff equivalent $NRA_{bms}(i,r)$ to the GTAP average tariff for each commodity.

$$TMS_{NRA}(i,s,r) = \text{RATIO}(i,r) * TMS(i,s,r) \quad (5)$$

where

$$\text{RATIO}(i,r) = NRA_{bms}(i,r) / 100 * [\text{sum}(s, \text{REG}, (VIMS(i,s,r)/VIWS(i,s,r))) - 1] \quad (6)$$

By using this method, initial imports entering a country duty free maintain their zero-tariff status and it is assumed there are no additional trade distortions on goods entering from these countries. This means that we are assuming that all price gaps between the domestic and border prices are caused by the restrictions on trade with countries that do not have zero tariff access to the market. If the $\text{RATIO}(i,r)$ is above/below one, then the average import tariff (equation (3)) has to increase/decrease. This is done in multiple steps in the DAItGTAP program to exclude bilateral tariffs becoming negative when the ratio is below 1. In the special cases where there are import subsidies, we reduce all tariffs to zero and allocate a homogenous import subsidy across all bilateral trades in that product.

Even though we classify a country as an importer (self-sufficiency ≤ 1.01) in the GTAP database, these countries are often still exporting smaller amounts of the same commodity. This means that if there are any exports from a country where the NRA_{bms} is not zero, we also introduce export subsidies or taxes equivalent to the import barriers. This means that if the domestic price is above the world market price, for example, then an export subsidy has to be in place, otherwise the domestic producer would not export. In the GTAP database we found only one domestic price where for we had to implement this stylized approach in our representation of the NRA_{bms} in our alternative database.

⁵ For the EU countries the self-sufficiency ratio is calculated for the EU aggregated and not at the individual country level, thereby excluding intra-EU trade.

If a country is classified as an exporter (self-sufficiency > 1.01), we implement equation 4 above by allocating a homogenous export tax or subsidy across all bilateral exports. Once again, if a country subsidizes exports then the average import tariff has to be as large as the export subsidy. If the average import tariff is below the export subsidy rate then the import tariff is raised using the method outlined above.

A *second method* of adjusting import tariffs also is available in the code DAIttoGTAP program. This can be activated as an alternative to the above approach which was used by Valenzuela and Anderson (2008). In this second approach, we assume the initial ad valorem equivalent tariffs already embedded in the GTAP version 8/9 databases are already captured by the NRA_{bms} . Using this assumption, we can estimate the ad valorem equivalent of the non-tariff barrier (NTB) to trade as

$$NTB(i,r) = NRA_{bms}(i,r) - 100 * [\text{sum}(s, REG, (VIMS(i,s,r)/VIWS(i,s,r))) - 1] \quad (7)$$

This second method then adds the NTB to the already present tariff structure found in the GTAP database, so that

$$TMS_{NRA}(i,s,r) = NTB(i,r) + TMS(i,s,r) \quad (8)$$

This method adds an NTB across all imported goods even where there are zero tariffs. It thus assumes that NTBs effect all trade equally. Estimating NTBs using this method will result in both negative and positive non-tariff barriers. The question could be asked if the trade-weighted average tariff used here is understating the trade distortion imposed by prohibitive tariff, in which case the estimated NTB in this second method is too large. The opposite could be said about the first method, which puts all the NRA_{bms} adjustment into the applied tariff, and thereby perhaps better reflects the trade distortion imposed by prohibitive tariffs – but then it could be understating the NTBs on initial bilateral trades with zero tariffs.

Incorporating NRA_{dms} and NRA_i plus NPS

Domestic support, in the form of output subsidies and intermediate input subsidies, is only allocated to the primary agricultural commodities found in the GTAP database. Output subsidies are changed to mirror the NRA_{dms} estimates:

$$NRA_{dms}(i,r) = (VOA(i,r)/VOM(i,r) - 1) * 100 \quad (9)$$

In the case of intermediate input subsidies, the commodity specific NRA_i is the ad valorem equivalent of the sum of each individual input's NRA times its input-output coefficient. Thus $NRA = NRA_{bms} + NRA_{dms} + NRA_i$. But to get NRA_i into the GTAP database as an intermediate input subsidy, we have to reverse this calculation to get the correct shocks for the TFD and TFM taxes in the GTAP database. This is done by dividing the NRA_i by the $SHARE$ of intermediates in total demand for inputs and then using the relationship between the market price $NRA(i,r)$ and the intermediate price to calculate the relative power of the input subsidies for domestic and imported commodities (equations 11 and 12).

$$SHARE(i,r) = \frac{\text{sum}(a, \text{demd_comm}, VIFA(a,i,r) + VDFA(a,i,r))}{[(\text{sum}(a, \text{demd_comm}, VIFA(a,i,r) + VDFA(a,i,r))}] \quad (10)$$

$$+ \text{sum}(a, \text{endw_comm}, \text{EVFA}(a, i, r))]$$

$$\text{TFD}_{\text{NRA}}(i, r) = (1 + \text{NRA}(i, r)/100 - ((\text{NRA}_i(i, r)/100)/\text{SHARE}(i, r)))/(1 + \text{NRA}(i, r)/100) \quad (11)$$

$$\text{TFM}_{\text{NRA}}(i, r) = \text{TFD}_{\text{NRA}}(i, r) \quad (12)$$

With regard to the NPS input subsidies, these are only issues for non OECD PSE countries. Since the DAI's NPS input subsidies already are included in the GTAP database for countries where the OECD calculates a PSE, we make no changes to the GTAP database for these countries. For the remaining countries where the DAI database contains a value for NPS inputs subsidies we calculate a generic homogenous input subsidy rate (13) on all intermediate inputs (a) in primary agricultural production (i).

$$\text{NPS}_{\text{ratio}}(r) = - (\text{NPS}(r)/1000000) / \text{sum}(a, \text{trad_comm}, \text{sum}(i, \text{primary}, \text{VDFM}(a, i, r) + \text{VIFM}(a, i, r))) \quad (13)$$

This is then added to the commodity specific input subsidy rate. The calculated price relationships in equation 11, 12 and 13 are then calibrated into the GTAP database as homogenous input subsidies between the agent and market prices of intermediate inputs in non OCED PSE countries (equations 14 and 15)

$$\text{TFD}_{\text{NRA}}(i, r) + \text{NPS}_{\text{ratio}}(r) = \text{VDFA}(a, i, r)/\text{VDFM}(a, i, r) \quad (14)$$

$$\text{TFM}_{\text{NRA}}(i, r) + \text{NPS}_{\text{ratio}}(r) = \text{VIFA}(a, i, r)/\text{VIFM}(a, i, r) \quad (15)$$

The above method of calibrating the DAI's NRA for the year 2007 or 2011 has been programed into the GEMPACK file DAItGTAP.tab. This TAB file also documents our approach and gives the end user the possibility of choosing between the two methods outlined above.

Input/Output to/from the DAItGTAP program

The DAItGTAP GEMPCK TAB file should be downloadable together with this document as well as the associated DAI data found in the DAI2007.har (DAI2011.har) file for the GTAP v8.1 (v9) database.⁶ Other files needed to run the program are the output from your aggregation of the v8.1 (v9) database, Basedata.har, Default.parm and Sets.har (see the Readme document for how to run the program).

The DAItGTAP produces three output files, DAIsbk.har, Altermx.prm and DAView.har.

The DAIsbk.har file contains shocks to import tariffs (tms), export taxes (txs), output subsidies (to) and intermediate input subsidies (tfd, tfm) for any specific aggregation of the GTAP v8.1 (v9) database. These shocks can then be used together with the Altermx.prm file to run an Altermx closure of the GTAP model (Hertel 1997), changing the initial distortions found in the GTAP database to the NRA estimates.

The DAView.har file containing an overview of the changes made to the GTAP v8.1 database is shown, by way of example, in Table 1.

⁶ When the GTAP v9 database is released, a DAI2011.har file will also become available. This can be used together with the DAItGTAP program to generate shock files for changing the GTAP v9 database's distortions to agricultural incentives.

Table 1. Overview DAIview.har

	Header	Coeff	Name
1	DAIG	DAIgeneral	DAI data with general information by country
2	DAIC	DAIcomREG	DAI data with commodity specific information by country
3	NRA_	NRA	NRA = NRAbms+NRArms+NRAi & production mill US\$
4	BMS	NRAbms	Border measures
5	DMS	NRArms	Output subsidies
6	I	NRAi	Intermediate input subsidies NRAi + NPS

Table 1's first two headers, DAIG and DAIC, contains the original 2007 DAI data downloaded from the World Bank's website. Two adjustments have been made to the original data: where TrStat2 was noted as x, m, h they are now coded so that x = 1, m = 2, h = 3 and Region is now Africa = 1, Asia (excluding Japan) = 2, ECA = 3, HIC = 4 LAC = 5.

Header 3, NRA_ gives an overview of the NRAs used to recalibrate the GTAP database, with the exception of NotCovered commodities which is excluded.

Taking c_b as an example in Table 2, the border measure NRA_bms is raising the domestic price by 83% compared to the world market price. So if the world market price is set equal to 1.0 then the domestic Chinese price would be 1.83. The value of c_b at the farm gate is US\$1,980 million and the total value of primary agricultural production is US\$428,180 million for the year 2007 in China.

Header 4, BMS, shows the result of the recalibration of the border measures in the GTAP data base. In this header the average import tariffs/subsidies and export taxes/subsidies are shown for the individual countries.

Table 2. Header 3 NRA_, taking China as an example

	NRA	NRAbms	NRArms	NRAi	VOP_prod
pdr	-0.8	-0.8	0.0	0	41800
wht	14.3	14.3	-0.0	0	19100
gro	20.7	20.7	0.0	0	20900
v_f	0	0	0	0	6180
osd	9.3	9.3	0.0	0	5230
c_b	83.4	83.4	-0.0	0	1980
pfb	78.0	78.0	0.0	0	7490
ocr	0	0	0	0	0
ctl	0	0	0	0	0
oap	1.0	1.0	0.0	0	155100
rmk	-25.5	-25.5	0	0	13400
wol	0	0	0	0	0
NotCovered	9.8	9.8	0	0	157000
Total					428180

Taking China as an example again, Table 3 shows that the border measures are reducing the domestic price of rice by -0.8%. Since the self-sufficiency of rice is below 1.01, then China is classified as an importer of rice and the NRA_{bms} is classified as an import distortion (NRAbmsM). The initial v8.1 average import tariff is 17.0 (TMSold), which is then reduced to -0.8 (TMSnew). Since there is an import subsidy on rice we also impose an export tax of -0.8% (TXSnew). These measures are imposed on both commodities pdy and pcr in the GTAP database.

Looking at wht, China is assumed to be an exporter of wheat and since the domestic market price is 14.3% (NRAbmsX) above the world market price, we implement an export subsidy. Since there is an export subsidy the import tariff has to be as large as the export subsidy, so we also increase the average import tariff from 1.4 to 14.3%.

Since there is very little trade in c_b and rmk we maintain the initial GTAP distortions on these commodities and put the NRA_{bms} trade distortions on the refined commodities mil and sgr.

Table 3. Header BMS border measures, taking China as an example

	TMSold	TMSnew	NRAbmsM	TXSold	TXSnew	NRAbmsX	VOP_prod	Self_Suff
pdr	17.0	-0.8	-0.8	0	-0.8	0	41800	1.00
wht	1.4	14.3	0	0	14.3	14.3	19100	1.03
gro	1.9	20.7	0	0	20.7	20.7	20900	1.05
v_f	3.5	0	0	0	0	0	6180	1.01
osd	2.5	9.3	9.3	0	9.3	0	5230	0.76
c_b	2.0	2.0	0	0	0	0	1980	0.96
pfb	3.7	78.0	78.0	0	78.0	0	7490	0.72
ocr	8.0	8.0	0	0	0	0	0	1.27
ctl	1.9	1.9	0	0	0	0	0	0.97
oap	8.4	1.0	1.0	0	1.0	0	155100	1.00
rmk	0	0	0	0	0	0	13400	0.97
wol	37.4	37.4	0	0	0	0	0	0.77
cmt	10.5	10.5	0	0	0	0	0	0.97
omt	7.9	1.0	1.0	0	1.0	0	0	1.00
vol	1.6	9.3	9.3	0	9.3	0	0	0.76
mil	8.8	-25.5	-25.5	0	-25.5	0	0	0.97
pcr	2.5	-0.8	-0.8	0	-0.8	0	0	1.00
sgr	0.2	83.4	83.4	0	83.4	0	0	0.96
NotCovered		0	9.8	0	0	0	157000	-
Total							428180	

The BMS header shows the implemented changes in average border distortions for the 71 countries found both in the DAI and GTAP v8.1 database. In a similar manner, header DMS shows the old v8.1 output subsidy rates (TOold) and the new NRA_{dms} rates (TOnew). In header I the same is done for intermediate input subsidies on imported and domestically produced inputs.

In a similar manner, running the DAIToGTAP program together with the forthcoming DAI2011.har file and any aggregation of the GTAP v9 database will produce the same set of output files. These can then be used to change distortions to agricultural incentives in the forthcoming v9 database.

How different is this alternative distortions database?

As a way of exploring the difference between the 2007 GTAP v8.1 distortions to agricultural incentives and those provided from the World Bank's DAI database, we simulated full liberalization of all agricultural and processed food markets globally in 2007 (using v8.1) and 2011 (using v9) of the GTAP Model. Three sets of welfare effects of such a reform are presented in Table 4: those using the standard GTAP protection database, those using the DAI database as transposed with the first (tariff ratio) method, and those using the DAI database as transposed with the second method (that assumes NTBs on agricultural products apply to imports from all trading partners).

The results in Table 4 reveal four sets of differences: across countries/regions, across the two years shown, across the two methods of transposing DAI estimates, and across policy instruments. Overall, they suggest the standard GTAP protection database, by not including measures other than applied import tariffs and input distortions for developing countries, leads to an underestimate of the global welfare effects of agricultural distortions. For 2011 the problem is relatively minor, but for 2007 the welfare effect is underestimated by at last one-third in all three regions.

The total welfare effect for all developing countries is much larger in dollar terms in 2011 and 2007, especially using the GTAP database, but that is mainly because the developing economies are so much larger by 2011. When expressed as a percentage of GDP, the differences between the two periods is much less (see final two rows of Table 4).

As for the two alternative methods of dealing with import restrictions, when the estimated NTBs are applied to all trading partners including those with whom there is a zero-tariff arrangement, the estimated welfare cost of policies for many countries is slightly higher (i.e., the benefit from reform is greater) than with the ratio method, as is also true globally.

The most striking difference between the results from using the GTAP database and those from using the alternative DAI database stem from the different instruments used to distort prices. Table 5 subdivides the global welfare effects according to whether policies directly affect agricultural exports, imports, domestic output, domestic consumption, or intermediate farm inputs. It reveals that using the DAI database ensures that export taxes are taken into account. In both years they are estimated to account for around one-quarter of the global welfare costs of agricultural price distortions, and for as much as two-fifths in 2007, while the GTAP database suggests there are just minor export subsidies in place that slightly offset the adverse welfare effect of import restrictions. The extent of the price distortions as contributed by the various policy instruments in 2007, according to the GTAP and DAI databases, are shown for the major countries and residual regions in Table 6.

Table 4. Welfare effects on developing countries of full global agricultural liberalization of primary agric. and processed food products, 2007 and 2011 (EV, US\$ million)

	GTAP v8.1 (2007)			GTAP v9 pre release(2011)		
	Standard GTAP	DAI database:		Standard GTAP	DAI database:	
		Ratio	NTB		Ratio	NTB
China	8576	11174	11052	17855	23548	23556
Indonesia	1309	500	708	896	1305	1976
Malaysia	1745	2678	2917	2616	2947	3145
Philippines	-144	-128	-136	129	396	384
Thailand	1899	3013	3084	3393	4233	4217
South Korea	6403	9434	9886	12047	10358	10408
Taiwan	-178	94	95	-270	-278	-284
India	3468	2324	3435	4697	2281	5182
Pakistan	-306	1845	1829	-15	56	36
Sri Lanka	92	58	-115	159	232	220
Bangladesh	-185	644	698	-329	-112	-120
Rest of Asia	3449	3233	3379	5902	4346	4057
Asia	26128	34868	36833	47079	49311	52777
Mexico	706	798	781	393	1001	1016
Argentina	2889	6652	5886	4823	4988	4445
Chile	493	474	511	1152	1328	1395
Ecuador	357	1225	1184	1026	2926	2842
Colombia	300	1152	1166	1201	1991	1987
Brazil	10240	10977	10831	13960	11770	11911
Rest Latin America	1863	2783	2764	3152	3803	3700
Latin America	16847	24062	23123	25707	27807	27297
North Africa	-591	477	504	-907	-219	-188
Morocco	145	153	329	393	425	469
Ghana	83	918	882	372	1420	1420
Egypt	-87	2621	2733	1489	3257	3155
South Africa	743	1120	1152	1434	1549	1420
Madagascar	33	736	732	31	547	547
Burkina Faso	20	-50	19	34	41	42
Kenya	546	850	816	855	910	1004
Cameroon	57	45	50	64	81	77
Ethiopia	184	439	438	323	447	444
Tanzania	122	523	522	157	1181	1180
Uganda	94	181	180	158	395	393
Nigeria	-55	190	229	-719	475	457
Mozambique	31	35	33	46	98	99
Rest of Africa	424	1750	1721	931	801	645
Africa	1748	9988	10338	4662	11409	11167
ALL DEV. COUNTRIES	45405	73459	74925	78139	93517	96288
% of GDP	0.34	0.55	0.56	0.36	0.43	0.44

Table 5. Welfare contributions on developing countries from agricultural import, export, output and input price distortions in the full global liberalization of primary agric. and processed food products

	EV	% contribution from policies affecting:					
	US\$m	Imports	Exports	Outputs	Inputs	Consumer	Total
2007							
Standard	45405	52	-1	6	6	20	100
DAI--ratio	73459	38	28	6	4	15	100
DAI--NTB	74925	39	27	6	4	14	100
2011							
Standard	78139	50	-1	7	6	22	100
DAI--ratio	93517	36	22	5	5	18	100
DAI--NTB	96288	38	21	5	5	17	100

Table 6. GTAP V8.1 and the updated GTAP DAI database's agricultural price distortions, 2007
(percent)

		GTAP V8.1						DAI updated V8.1 (Ratio)					
		Import	Subsidy					Import	Subsidy				
	Agriculture	Tariff	Export	Output	Input	Factor	Consumer	Tariff	Export	Output	Input	Factor	Consumer
Europe	Prim.	2.1	0.1	0.3	0.8	27.5	0.2	2.8	1.9	0.2	0.8	27.5	0.2
	Sec.	3.6	0.6	-5.3	-0.5	0.0	-16.9	3.6	1.0	-5.3	-0.5	0.0	-16.9
Russia	Prim.	5.5	-0.1	0.0	5.2	7.3	-4.1	8.2	-16.8	0.6	5.2	7.2	-4.1
	Sec.	17.7	0.0	0.0	-0.5	0.0	-34.9	26.3	10.2	0.0	-0.5	0.0	-34.9
Central Asia	Prim.	5.4	0.0	-1.0	1.1	3.3	-1.2	5.3	-2.2	0.6	1.2	3.2	-1.2
	Sec.	11.5	0.0	-2.1	-0.2	0.0	-13.5	11.1	4.7	-2.1	-0.2	0.0	-13.5
Middle East	Prim.	8.0	0.0	0.9	-4.5	4.2	-0.3	-3.5	4.5	11.5	-6.4	3.9	-0.3
	Sec.	13.7	0.0	-3.7	-0.4	0.0	-3.4	13.1	0.5	-3.7	-0.4	0.0	-3.4
USA	Prim.	1.7	0.0	0.1	3.1	7.5	-5.0	1.6	8.2	-0.1	3.1	7.4	-5.0
	Sec.	3.0	0.0	-0.8	-0.2	0.0	-9.8	3.7	2.2	-0.8	-0.2	0.0	-9.8
Canada	Prim.	1.2	0.0	0.0	0.2	21.2	1.7	1.1	0.7	0.0	0.2	20.6	1.7
	Sec.	17.0	0.0	-0.5	-0.1	0.0	-34.5	14.8	2.2	-0.5	-0.1	0.0	-34.5
Australia	Prim.	0.3	0.0	0.0	5.4	4.7	-2.4	0.3	0.0	0.0	5.4	4.7	-2.4
	Sec.	1.5	0.0	-4.5	-0.1	0.0	-31.5	1.3	0.0	-4.5	-0.1	0.0	-31.5
Rest of Oceania	Prim.	1.7	0.0	0.0	0.2	0.0	-10.0	2.1	1.3	0.0	0.2	0.0	-10.0
	Sec.	5.0	0.0	-0.5	0.0	0.0	-12.3	5.1	0.1	-0.6	0.0	0.0	-12.3
Japan	Prim.	12.2	0.0	2.3	1.1	8.2	-5.0	12.6	25.5	1.7	1.1	8.3	-5.0
	Sec.	19.6	0.0	-8.4	-0.4	0.0	-5.0	24.0	3.1	-8.4	-0.4	0.0	-5.0
China	Prim.	6.0	0.0	0.0	27.7	29.1	-0.4	16.1	3.1	0.0	27.7	29.1	-0.4
	Sec.	6.2	0.0	0.0	-0.1	0.0	-12.8	7.4	0.1	0.0	-0.1	0.0	-12.8
Indonesia	Prim.	2.4	0.0	0.0	8.4	0.4	-1.1	3.2	5.4	0.0	8.4	0.4	-1.1
	Sec.	9.0	0.0	0.0	0.0	0.0	-8.2	15.5	-3.8	0.0	0.0	0.0	-8.2
Malaysia	Prim.	7.8	0.0	1.1	0.0	0.0	-3.7	5.1	2.7	0.0	0.0	0.0	-3.7
	Sec.	8.9	0.0	0.0	0.3	0.0	-8.0	9.5	-33.3	0.0	0.3	0.0	-8.0
Philippines	Prim.	6.0	0.0	0.0	-0.1	0.0	-3.4	6.9	-13.2	0.0	0.0	0.0	-3.4
	Sec.	12.8	0.0	0.0	-0.2	0.0	-5.3	10.7	3.5	0.0	-0.2	0.0	-5.3
Thailand	Prim.	10.5	0.0	0.0	-1.6	0.0	0.0	5.9	2.2	0.0	0.0	0.0	0.0
	Sec.	14.0	0.0	0.0	-0.2	0.0	-20.5	11.5	16.0	0.0	-0.2	0.0	-20.5
Vietnam	Prim.	9.2	0.0	-1.0	0.0	0.0	-2.7	9.2	0.0	-1.0	0.0	0.0	-2.7
	Sec.	16.6	0.0	-0.5	0.0	0.0	-17.7	16.7	0.0	-0.5	0.0	0.0	-17.7
RestAsia	Prim.	0.7	0.0	-0.1	-0.1	0.0	-1.2	0.7	0.0	-0.1	-0.1	0.0	-1.2
	Sec.	2.0	0.0	-1.9	-0.1	0.0	-7.1	2.0	0.0	-1.9	-0.1	0.0	-7.1
South Korea	Prim.	24.8	6.8	0.0	1.9	8.2	-3.3	66.0	91.4	2.8	2.0	7.8	-3.3
	Sec.	29.6	0.2	-12.1	-0.2	0.0	-21.7	50.2	3.0	-12.1	-0.2	0.0	-21.7
Taiwan	Prim.	6.0	0.0	-0.4	-0.1	0.0	0.0	10.0	14.0	-0.2	-0.1	0.0	0.0
	Sec.	14.1	0.0	-6.8	-0.2	0.0	-0.6	19.9	2.7	-6.7	-0.2	0.0	-0.6
India	Prim.	42.2	0.0	4.6	-0.7	0.0	1.7	3.2	2.2	0.0	24.0	0.0	1.7
	Sec.	78.8	0.0	-1.6	-2.6	0.0	-3.6	18.0	17.8	-1.5	-2.6	0.0	-3.6
Pakistan	Prim.	6.2	0.6	0.0	-0.1	0.0	-0.5	3.1	-14.1	0.0	0.0	0.0	-0.5
	Sec.	20.1	0.0	0.0	-0.2	0.0	-11.3	17.5	-10.2	0.0	-0.2	0.0	-11.3

SriLanka	Prim.	13.8	0.0	0.6	0.0	0.0	0.0	14.3	14.2	0.0	0.0	0.0	0.0
	Sec.	22.7	0.0	0.0	0.0	0.0	0.0	19.1	-0.2	0.0	0.0	0.0	0.0
Bangladesh	Prim.	4.7	0.8	-1.3	-0.3	0.0	0.0	-25.6	-28.9	-0.1	0.0	0.0	0.0
	Sec.	9.0	0.0	-1.8	0.0	0.0	-1.7	7.0	-0.1	-1.8	0.0	0.0	-1.7
Mexico	Prim.	5.1	0.3	0.4	9.4	8.1	-0.1	0.3	0.1	0.1	9.4	8.2	-0.1
	Sec.	2.7	0.0	-0.2	0.0	0.0	-9.1	2.6	1.5	-0.2	0.0	0.0	-9.1
Argentina	Prim.	0.7	0.0	-5.0	-4.3	0.0	-69.5	0.8	-26.2	-1.5	-0.9	0.0	-69.5
	Sec.	4.7	0.0	-2.2	-0.1	0.0	-37.2	4.7	-27.4	-2.4	-0.1	0.0	-37.2
Chile	Prim.	0.7	0.0	-1.7	-0.4	0.0	-28.0	1.0	0.0	-0.2	-0.4	0.0	-28.0
	Sec.	1.8	0.0	-0.5	-0.2	0.0	-25.4	1.9	0.6	-0.5	-0.2	0.0	-25.4
Ecuador	Prim.	7.9	0.0	0.0	0.0	0.0	0.0	1.0	-35.7	0.0	0.0	0.0	0.0
	Sec.	9.2	0.0	-1.4	-0.1	0.0	-3.1	1.3	-0.1	-1.4	-0.1	0.0	-3.1
Colombia	Prim.	13.3	0.0	0.3	-1.4	0.0	-1.3	-0.4	-23.7	0.1	-0.4	0.0	-1.3
	Sec.	9.2	0.0	-0.7	-0.3	0.0	-13.4	-0.2	14.3	-0.7	-0.3	0.0	-13.4
Brazil	Prim.	2.0	0.0	1.5	0.8	7.8	-8.8	2.4	1.2	1.6	0.8	7.8	-8.8
	Sec.	6.0	0.0	-0.8	-0.2	0.0	-15.2	6.4	0.4	-0.8	-0.2	0.0	-15.2
RestLamerica	Prim.	6.6	0.0	-0.5	-0.4	0.0	-2.4	6.6	-1.9	-0.5	-0.4	0.0	-2.4
	Sec.	12.6	0.0	-1.5	-0.1	0.0	-9.5	12.2	-0.3	-1.5	-0.1	0.0	-9.5
Nafrica	Prim.	17.0	0.0	-3.9	0.0	0.0	0.0	17.0	0.0	-3.9	0.0	0.0	0.0
	Sec.	11.5	0.0	-4.4	0.0	0.0	0.0	11.5	0.0	-4.4	0.0	0.0	0.0
Morocco	Prim.	25.9	0.0	-0.1	0.0	0.0	0.0	27.1	21.6	-4.1	2.2	0.0	0.0
	Sec.	25.3	0.0	-0.2	0.0	0.0	0.0	29.1	6.4	-0.2	0.0	0.0	0.0
Ghana	Prim.	6.6	0.0	0.0	0.0	0.0	-0.2	6.7	-23.9	0.0	0.0	0.0	-0.2
	Sec.	16.2	0.0	0.0	0.0	0.0	-7.4	17.9	0.1	0.0	0.0	0.0	-7.4
Egypt	Prim.	2.6	0.0	0.0	0.0	0.0	0.0	-4.1	-6.1	0.0	0.0	0.0	0.0
	Sec.	21.0	0.0	0.0	0.0	0.0	0.0	4.5	-5.9	0.0	0.0	0.0	0.0
SouthAfrica	Prim.	3.7	0.0	0.0	1.7	6.0	-5.0	2.3	0.0	0.0	1.7	6.0	-5.0
	Sec.	9.2	0.0	-0.3	0.0	0.0	-14.3	8.0	7.8	-0.3	0.0	0.0	-14.3
Madagascar	Prim.	4.4	0.0	0.0	0.0	0.0	0.0	5.4	-46.3	0.0	0.0	0.0	0.0
	Sec.	8.3	0.0	-0.5	0.0	0.0	0.0	17.9	1.1	-0.5	0.0	0.0	0.0
Burkina Faso	Prim.	4.9	0.0	-0.1	0.0	0.0	-0.3	3.8	3.0	0.0	0.0	0.0	-0.3
	Sec.	8.6	0.0	-1.4	0.0	0.0	-5.0	8.6	0.0	-1.4	0.0	0.0	-5.0
Kenya	Prim.	3.6	0.0	2.7	0.0	0.0	-0.1	9.5	-10.6	1.4	0.0	0.0	-0.1
	Sec.	22.7	0.0	2.8	0.0	0.0	-0.1	25.2	1.3	2.8	0.0	0.0	-0.1
Cameroon	Prim.	10.8	0.0	0.0	0.0	0.0	-0.1	9.8	-3.5	0.0	0.0	0.0	-0.1
	Sec.	16.0	0.0	-0.2	-0.1	0.0	-4.8	16.0	0.0	-0.2	-0.1	0.0	-4.8
Ethiopia	Prim.	7.3	0.0	0.0	0.0	0.0	-0.1	14.8	-14.2	2.5	0.0	0.0	-0.1
	Sec.	21.9	0.0	0.0	-0.1	0.0	-10.8	21.9	0.0	0.0	-0.1	0.0	-10.8
Tanzania	Prim.	1.9	0.0	0.0	0.0	0.0	-2.0	30.3	-17.0	0.0	0.0	0.0	-2.0
	Sec.	21.8	0.0	0.0	0.0	0.0	-11.0	26.5	9.4	0.0	0.0	0.0	-11.0
Uganda	Prim.	7.2	0.0	-0.1	0.0	0.0	-2.7	7.2	-26.5	0.0	0.0	0.0	-2.7
	Sec.	19.9	0.0	-0.6	0.0	0.0	-6.5	20.1	0.0	-0.6	0.0	0.0	-6.5
Nigeria	Prim.	6.3	0.0	-0.1	0.0	0.0	-0.2	6.8	16.1	-2.4	0.0	0.0	-0.2
	Sec.	20.6	0.0	-1.8	0.0	0.0	0.0	11.3	-0.4	-1.8	0.0	0.0	0.0

Mozambique	Prim.	5.9	0.0	0.0	0.0	0.0	-0.4	5.2	-2.4	0.0	0.0	0.0	-0.4
	Sec.	10.1	0.0	0.0	0.0	0.0	-10.5	21.4	17.5	0.0	0.0	0.0	-10.5
RestSSAfrica	Prim.	6.4	0.0	-0.5	0.0	0.0	-0.8	5.9	-15.4	-0.5	0.0	0.0	-0.8
	Sec.	13.9	0.0	-1.1	0.0	0.0	-8.2	15.9	0.2	-1.1	0.0	0.0	-8.2

References

- Anderson, K. (ed.) (2009), *Distortions to Agricultural Incentives: A Global Perspective, 1955 to 2007*, London: Palgrave Macmillan and Washington DC: World Bank.
- Anderson, K., J. Cockburn and W. Martin (eds.) (2010), *Agricultural Price Distortions, Inequality and Poverty*, Washington DC: World Bank.
- Anderson, K., M. Kurzweil, W. Martin, D. Sandri and E. Valenzuela (2008), 'Measuring Distortions to Agricultural Incentives, Revisited', *World Trade Review* 7(4): 1-30, October.
- Anderson, K. and W. Martin (eds.) (2009), *Distortions to Agricultural Incentives in Asia*, Washington DC: World Bank.
- Anderson, K. and W. Masters (eds.) (2009), *Distortions to Agricultural Incentives in Africa*, Washington DC: World Bank.
- Anderson, K. and S. Nelgen (2013), *Updated National and Global Estimates of Distortions to Agricultural Incentives, 1955 to 2011*, Database uploaded in June at www.worldbank.org/agdistortions.
- Anderson, K. and J. Swinnen (eds.) (2008), *Distortions to Agricultural Incentives in Europe's Transition Economies*, Washington DC: World Bank.
- Anderson, K. and A. Valdés (eds.) (2008), *Distortions to Agricultural Incentives in Latin America*, Washington DC: World Bank.
- Narayanan, B.G., A. Aguiar and R. McDougall (eds.) (2012), *Global Trade, Assistance, and Production: The GTAP 8 Database Base*, Center for Global Trade Analysis, Purdue University, West Lafayette IN. Available online at: http://www.gtap.agecon.purdue.edu/databases/v8/v8_doco.asp
- Narayanan, B.G., R. McDougall et al. (eds.) (2014), *Global Trade, Assistance, and Production: The GTAP 9 Database Base*, Center for Global Trade Analysis, Purdue University, West Lafayette IN (forthcoming).
- Harrison, J., M. Horridge, M. Jerie and K. Pearson (2014), *GEMPACK Manual*, GEMPACK Software, Centre of Policy Studies, Victoria University, Melbourne, March, ISBN 978-1-921654-34-3
- Hertel, T.W. (ed.) (1997), *Global Trade Analysis: Modeling and Applications*, Cambridge and New York: Cambridge University Press.
- Malcolm, G. (1998), 'Adjusting Tax Rates in the GTAP Data Base', *GTAP Technical Paper* No. 12, Purdue University, West Lafayette IN, September.

- OECD (2014). Agricultural Policies and Support. Producer and Consumer Support Estimates database <http://www.oecd.org/tad/agricultural-policies/producerandconsumersupportestimatesdatabase.htm>
- Valenzuela, E. and K. Anderson (2008), 'Alternative Agricultural Price Distortions for CGE Analysis of Developing Countries, 2004 and 1980-84', Research Memorandum No. 13, Center for Global Trade Analysis, Purdue University, West Lafayette IN, December, at www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=2925